

## INTERFACE APPARATUS FOR TOUCH INPUT AND TACTILE OUTPUT COMMUNICATION

### BACKGROUND OF THE INVENTION

**[0001]** The invention relates to a touch device interface. By way of example, the inventive touch device interface can be used as a user-input section of a touch screen interface. Although a touch screen appears to be a unitary piece of hardware, it actually comprises an output device, namely a display or screen, and an input device which is sensitive to touching or approaching the surface of the display with a finger or stylus. Touch screens can be implemented by organizing an x-y matrix of infrared rays over the screen, in which case touching the display surface is not necessary. Alternatively the screen can be overlaid by a transparent pressure-sensitive switch matrix which is scanned in substantially similarly to the way electronic keyboard matrices are scanned. The layout of the switch matrix may resemble that of a general-purpose typewriter, or the layout may be dedicated to specific purposes or applications. Touch screen interfaces are frequently used in connection with laptop or palmtop computers, personal digital assistants ("PDA"), remote control devices, digital cameras, navigators, entertainment devices, and many other types of devices.

**[0002]** A problem with conventional touch screen interfaces is that the user of the touch screen interface must be able to see the layout of the switch matrix in order to be able to select a specific key to be activated ("pushed"). Seeing the layout of the switch matrix is not always possible or easy, and visually impaired persons are a prime example. Even in cases wherein the user could see the switch matrix layout, looking at the switch matrix layout may disturb the user, such as the driver of a car.

### BRIEF DESCRIPTION OF THE INVENTION

**[0003]** An object of the invention is to develop a method and equipment so as to alleviate one or more of the problems identified above. In other words the object of the invention is to provide an improved touch screen interface which requires less visual attention from its user than prior art touch screen interfaces do. The object of the invention is attained by methods and equipment as specified in the attached independent claims. The dependent claims and the present description relate to specific embodiments of the invention.

**[0004]** An aspect of the invention is a interface apparatus according to claim 1. The interface apparatus according to claim 1, which provides two-way communication with the user, comprises a touch input section and a tactile output section. The term "section" implies that the touch input section and a tactile output section are comprised within the two-way interface apparatus. The touch input section comprises a surface arranged so as to be touched or approached by a body member, which typically is the user's finger. This surface may be called a touch surface. The touch surface has at least one touch-sensitive area having a predetermined position. The touch input section comprises or is operatively connectable to data processing means for assigning at least one function to the least one touch-sensitive area. The touch input section comprises presence-detecting means for detecting a presence or absence of a user's body member near the at least one touch-sensitive area. Touch-sensitive smart phones, car navigators, touch pads of laptop or palmtop computers, or

the like provide illustrative but non-restrictive examples of the touch input section. The data processing means comprises an appropriately programmed microprocessor with associated hardware. The microprocessor and its associated hardware can reside within the interface apparatus or in an external data processing system. The presence-detecting means are typically implemented by appropriate programming of the microprocessor: the surface touched or approached by the body member is typically arranged as an X-Y matrix which is scanned by the associated electronics of the touch input section. When the user's body member presses an area of the surface, one or more of the X lines are connected to one or more of the Y lines, and the X and Y coordinates of the connection are detected by the processor. The X and Y coordinates are typically compared with coordinates that define predetermined areas.

**[0005]** In an illustrative but non-restrictive example, the function assigned to the touch-sensitive area is providing an input to an application program, such as a selection of an option ("yes/no/cancel") or a selection of an act to be performed. The border or perimeter of the touch-sensitive area need not be a sharply-defined one, so long as it is possible to say that touching or approaching a point within the touch-sensitive area invokes the function assigned to the touch-sensitive area, while touching or approaching another point outside the area does not.

**[0006]** The number of functions assigned to a touch-sensitive area is not restricted to one. Instead it is possible to assign multiple functions to one, some or all touch-sensitive areas, such that a single touch ("click") invokes a first function, two touches within a predefined time window ("double click") invokes a second function, and so on.

**[0007]** An illustrative example of an interface apparatus which comprises the function-assigning means is a stand-alone device, such as a palmtop computer, a smart telephone or a remote controller. An illustrative example of a touch device which is connectable to the function-assigning means is an interface panel which does not contain any application-level programs but is connectable to an external data processing equipment executing one or more application-level programs which use the interface panel as an input device. In such environments it is beneficial to define an application programming interface (API), via which the application-level programs can accept input from a user, and optionally provide feedback to the user.

**[0008]** As regards functionality, the touch input section can be implemented via conventional technology. As stated earlier, the conventional technology causes the problem that the user must see what area(s) of the touch input section need to be pushed.

**[0009]** In order to solve the problems associated with conventional touch input technology, the inventive interface apparatus also comprises a tactile output section, which in turn comprises an electro-sensory stimulus generator for generating an electro-sensory stimulus to the body member. The electro-sensory stimulus generator comprises one or more conducting electrodes, each conducting electrode being provided with an insulator wherein, when the body member is proximate to the conducting electrode, the insulator prevents flow of direct current from the conducting electrode to the body member and a capacitive coupling over the insulator is formed between the conducting electrode and the body member. The electro-sensory stimulus generator also comprises a high-voltage source for applying an electrical drive to the one